Convertible vehicle

The invention relates to a convertible vehicle with at least one flexible front and one rigid rear area according to the preamble of Claim 1 and the preamble of Claim 3.

DE 101 40 232 A1 shows a convertible vehicle with a rigid rear roof part and a flexible roof area connected to it in the direction of travel, which includes a roof covering supported by several transverse convertible-top bows. The convertible-top bows are connected to each other in a known manner by lateral frame parts. These frame parts are pivoted around vertical axes opposite to each other for opening the flexible roof area. Several drives arranged on the corresponding longitudinal sides of the vehicle are used for this purpose. In order to guarantee uniform shortening of the roof area in the opening phase, these must be synchronized with each other, which is expensive. In addition, the folding mechanism of the side frame parts shown is complicated, and additional steps must be taken in order to avoid uncontrolled unfolding of the roof covering and jamming in the joint areas.

The invention is based on the problem of optimizing a convertible vehicle of the type mentioned type with respect to opening motion of the flexible roof area.

The invention solves this problem with a convertible vehicle with the features of Claim 1 and a convertible vehicle with the features of Claim 3, which can be implemented individually or in combination with each other. Advantageous embodiments of the object of the invention can be seen in from the additional Claims 2 and 4 through 11.

Through the design according to Claim 1 according to the invention, a conventional folding mechanism is created in the front roof area, which has long been known in fully flexible convertible tops and is therefore easy to handle. Through the foldability of the lateral frame parts, no synchronization problems are produced and the folded section already enters the position required for opening by its own weight. A situation is therefore prevented in which opposite longitudinal side areas are moved rearward at different speeds during roof opening, making the flexible roof area slanted.

Folding occurs particularly advantageously, in that a roof peak is not reversed in the opening position and therefore remains arched relative to the rear roof part in the same direction, beneath which it can be accommodated. The roof peak can then conform to the rear roof part very closely, so that a minimized packing dimension of the roof results.

In the design according to the invention according to Claim 3, which is advantageously combined with the features of Claims 1 and 2, the mechanism is simplified. By rigid connection of the rear lateral frame part to the rear rigid roof part, no separate movement mechanism need be provided for the lateral frame part. This frame part, which extends upward from the window parapet line and is often also referred to as the main column, can then be moved with the rigid rear roof part without its own drive or control requirements.

To avoid increased tensile stress on the covering, it is particularly helpful if at least one convertible-top bow lying in the rear area of the flexible roof area passes beneath the covering only when the roof is closed and is separated from it during roof opening. Folding of the covering can also be optimized in that during roof opening, it is positioned closely beneath the rear roof part, therefore in a space-saving manner.

Folding can be further improved if the covering remains firmly connected, in addition to the front roof peak, only to a convertible-top bow lying between the front frame parts, a convertible-top bow movable with respect to the lateral frame parts, and in the vicinity of the upper edge of the rear roof part during the entire roof movement.

A simplification of the control of the roof movement can be achieved if two different movement mechanisms are provided, on one hand, to move the rear roof area from its closed position into an intermediate position that permits opening of a cover part situated beneath it, and, on the other hand, to move the entire roof farther.

In particular, the control requirements are reduced if a drive device of the first movement mechanism remains deactivated in the second movement phase and serves only as a mechanical coupling.

Additional advantages and features of the invention cam be seen from a embodiment example of the object of the invention, shown in the drawing and described below.

In the drawing:

Fig. 1 through Fig. 10[1] show a complete process of roof opening in a schematic side view of the middle vehicle area, viewed from the inside, in which

Fig. 1 shows the position in the closed roof with the rear cover part additionally shown, along with the front windshield frame and the roof covering, as well as the head-movement curves of the occupants,

Fig. 2 shows a view similar to Fig. 1 during upward movement of the rear roof area with the front roof area still closed,

Fig. 3 shows a view similar to Fig. 2 at the end of upward movement of the rear roof area, with a front roof area just opening and the cover part already opened to release a passage opening for the roof,

Fig. 4 also shows a view similar to Fig. 3 at the beginning of the second movement phase, with opening of the front roof area,

Fig. 5 shows a view similar to Fig. 4 as the roof opening proceeds,

Fig. 6 shows a view similar to Fig. 5, with the roof opening proceeding further, shown without the rear cover part and other vehicle lines in the interest of clarity,

[1] Translator Note: Error in source text. This should be "Fig. 1 through Fig. 9".

Fig. 7 shows a view similar to Fig. 6, with the roof opening proceeding further,

Fig. 8 shows a view similar to Fig. 7, with the roof opening proceeding further,

Fig. 9 shows a view similar to Fig. 8 with the roof completely opened

Fig. 10 to Fig. 18 show a complete process of roof opening in a schematic side view of the middle vehicle area, viewed from the outside, in which:

Fig. 10 shows the roof in the fully closed position with the rear cover part, front windshield frame, and roof covering, as well as head movement curves of the occupants shown additionally.

Fig. 11 shows the roof in the position according to Fig. 2, but without the covering being shown,

Fig. 12 shows the roof in a view similar to Fig. 11, but at the end of the upward movement of the rear roof part and with the front roof part still closed,

Fig. 13 shows the roof in a position similar to that of Fig. 4,

Fig. 14 shows the roof in a position similar to that of Fig. 5, but, in the interest of clarity, without the cover part and additional body lines being shown,

Fig. 15 shows the roof in a position similar to that of Fig. 6,

Fig. 16 shows the roof in a position similar to that of Fig. 7,

Fig. 17 shows the roof in a position similar to that of Fig. 8,

Fig. 18 shows the roof in the position as in Fig. 9.

The convertible vehicle 1 according to the invention is shown schematically in the diagrams in its upper and middle areas, which include the passenger compartment 3. This can be covered by a movable roof 2, which is closed in the views according to Fig. 1 and Fig. 10.

The roof 2 includes a rigid rear roof area 4, which is designed dome-like and includes an arched rear window 5, which can be provided with a light- and/or heat-absorbing coating outside of a center transparent area, and can extend with its transverse edge 11 into the lateral transverse outer edges of dome 4. A particularly good view to the rear is made possible by this.

The roof 2 also includes a front roof area 6 spanned with a covering 7 (only shown in Fig. 1 and Fig. 10). Several (for example, three here) lateral frame parts, connected to each other in the closed position with respect to the direction of travel F and running in the longitudinal direction of the vehicle after frame parts 8, 9, 10, are used to span this covering 7. The conditions are the same on both sides of the vehicle in this respect.

The rearmost frame part 8 extends from a window parapet line upward. It is rigidly connected to the rear roof part 4 and can therefore be moved together with it. The frame part 8 can enclose an upward opening angle with the lateral edge 11 of rear window 5. The intermediate space between frame part 8 and the edge 11 of rear window 5 can be lined.

The rear roof area 4 is connected to the body 12 through a first movement mechanism 27a. This includes a drive device 13, designed here as a hydraulic cylinder, two links 16, 17 mounted to pivot on an A-arm by means of articulations 14, 15, which are connected to additional articulations 18, 19 with a lever 20 that rigidly engages on the rear roof area 4. The first movement mechanism therefore includes a four-link suspension 14, 15, 18, 19 to move the rear roof area 4. In the first movement phase, the A-arm is not moved with respect to the body 12.

When the roof 2 is closed, the rear roof part 4 can stand on a cover part D, which is not necessary. The cover part D is a component here of a trunk lid H, which can be opened in two

opposite pivot directions and in one case exposes a loading opening for a trunk and in another case a passage opening for the roof. In addition, the cover part D in the embodiment example can be pivoted relative to the trunk lid H, so that the latter need not pivot out far and a large opening can be exposed by the relative movement of cover part D with respect to the lid H (Fig. 3, Fig. 12).

When the roof is closed (Fig. 1, Fig. 10), the flexible roof area, denoted overall with 6, is connected in the direction of travel F to the rigid roof part 4. This includes several (here three) transverse bows 21, 22, 23 that support the covering 7. The front convertible-top bow 23 is held between the frontmost side frame parts 10, which are also connected to each other through a cross-member 24, so that a roof peak, lockable on windshield frame 25, is formed. During the entire roof opening, this remains essentially in its original orientation, so that when the roof 2 is opened, it can lie tightly beneath and against the front edge 26 of the rear roof part 4, arched in the same direction, and thereby minimizes the packing dimension, especially in height.

The frontmost convertible-top bow 23 in direction travel F is connected to covering 7, as are the convertible-top bows 26 that are movable relative to the lateral frame parts 9. The rear convertible-top bow 21, held between frame parts 9 supports the covering 7, on the other hand, only when roof 2 is closed. During lateral opening, the covering 7 is released from this convertible-top bow 21. The covering 7 is therefore not directly connected to the middle frame 9, but is raised above it with lateral tightening cords to close the roof 2.

The covering 7 is therefore connected to the convertible-top bows 22, which can move with respect to the lateral frame parts 9 and to the rigid rear roof area 2 on its upper edge 26, in addition to the roof peak and the convertible-top bow 23 connected to the frontmost frame parts 10. It can therefore freely fold in the middle area, so that the convertible-top bows 21, 22, 23, when the roof is opened (Fig. 9, Fig. 18), are arranged tightly behind each other and, because of this, the total packing dimension can be minimized, especially in length.

The front roof area 6 can move through a second movement mechanism 27b, in which this is connected through a coupling rod 28 to the first rear movement mechanism. Movement of the

front roof area 6 therefore always also causes movement of the rear roof area 4, which, however, is not the case in reverse, as is explained further below in detail.

The second front movement mechanism 27b includes at least one drive device 29, here also designed as a hydraulic cylinder. This acts on a first four-link suspension 30 with levers 33, 34 connected to articulations 31, 32 on the body side, by which means the middle lateral frame part 9 is secured movably. Lever 33 is lengthened so that it also operates an additional four-link suspension 36 through a longitudinal coupling 35. This connects the two front frame parts 9, 10 through two levers 37, 38. The levers 37, 38 are fastened to pivot, on one side, by means of articulations 39, 40 on the middle frame part 10 and, on the other side, by means of articulations 41, 42 on the front frame part 10. The additional convertible-top bow 22, which can move with respect to frame part 9, is also secured on the longitudinal coupling 35.

To open the roof, in a first movement phase, only the rear roof section 4 is moved (transition from Fig. 1 to Fig. 2 or from Fig. 10 to Fig. 11). For this purpose, the piston of the drive device 13 of the first movement mechanism is retracted, so that the levers 16, 17 pivot upward and rearward about their articulations 14, 15 and, in so doing, move the lever and therefore the entire dome 4 upward and rearward. Since the front lever 16 is pivoted out above the vertical, the roof part 4 readily tilts forward at the end of the first movement phase, so that the covering 7 is relieved of its connection to edge 26 (transition from Fig. 11 to Fig. 12). The front roof area 6, during this movement phase, can still remain closed. Stress on the covering 7 is avoided.

At the end of this movement phase, the cover part D opens, optionally with trunk lid H.

In the subsequent second movement phase, the front roof area 6 opens by the drive device 29 being pushed over the second movement mechanism 27b and the rear roof part 4 then being moved by the coupling rods about its horizontal axes 45, 46, which lie transverse to the vehicle 1, and were unmoved in the first movement phase. In the entire second movement phase, the rear drive device 13, however, remains in its retracted end position and therefore represents a pure coupling element.

In the second movement phase, on the one hand, the front roof area 6 can therefore move beneath the rear roof area 4 and, on the other hand, by means of coupling 28, the entire roof 2 can be moved synchronously and without additional drive or control demands into the stored position within the body 12.

Each movement mechanism 27a, 27b therefore includes a drive device 13, 29, and the drive device 13 of the first movement mechanism 27a remains unaffected in the second movement phase and serves merely as a coupling.

During roof opening, the roof peak with the frontmost frame parts 10 is moved by the four-link suspension 36 parallel to the middle frame parts 9 rearward and upward about axes 39, 40, 41, 42 and retains its original orientation. At the same time, it is raised, like the middle roof frame parts 9, above the four-link suspension 30 that opens around axes 31, 32, 43, 44, so that the head freedom also increases for the rear occupants during roof opening, and during the critical storage of the front cross-support 24 of the roof peak, the head movement curve of the rear occupants is fully retained. The invention is therefore particularly useful for vehicles with two or more rows of seats, but also for two-seaters.

All frame parts 8, 9, 10 of the rear 4 and front 6 roof areas are therefore folded-in opposite to each other about the horizontal transverse axes 45, 46, 31, 32, 43, 44, 39, 40, 41, 42. Because of this, and through couplings 28, 35, as well as 13 in the second movement phase, the control expense is are reduced. Only one drive device 13, 29 need be operated in each movement phase, which then is necessarily assigned the roof movement. Synchronization is completely unnecessary; and the movement phases can also occur fully sequentially without any overlap.